Making the best of GPS

Derek Hanton

Senior Consultant (Area Manager)

SAC Consulting is a division of SRUC

Leading the way in Agriculture and Rural Research, Education and Consulting

Using GPS +/- variable rate applications to correct soil nutritional problems.

VRA seed and fertiliser

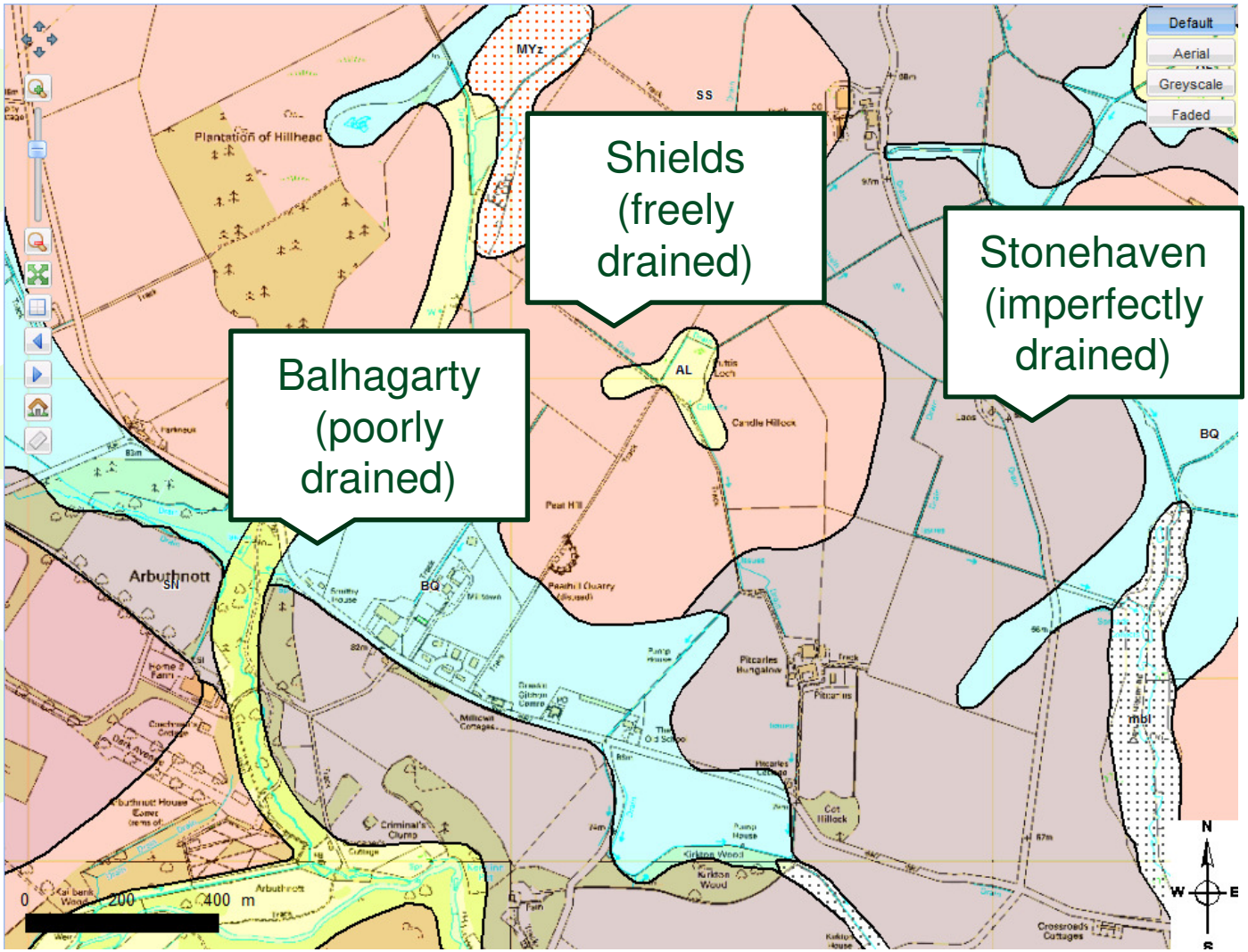
VRA fertiliser

VRA Lime

What are we trying to do?

- Grow a crop in a variable environment (soil and weather) to achieve optimum yields and consistent crop quality

Variation within an area and within a field



To do this we must

- Make efficient use of nutrients based on good root development
- Use organic and manufactured fertilisers efficiently and profitably
- Create good soil conditions through effective soil management

So what can we do?

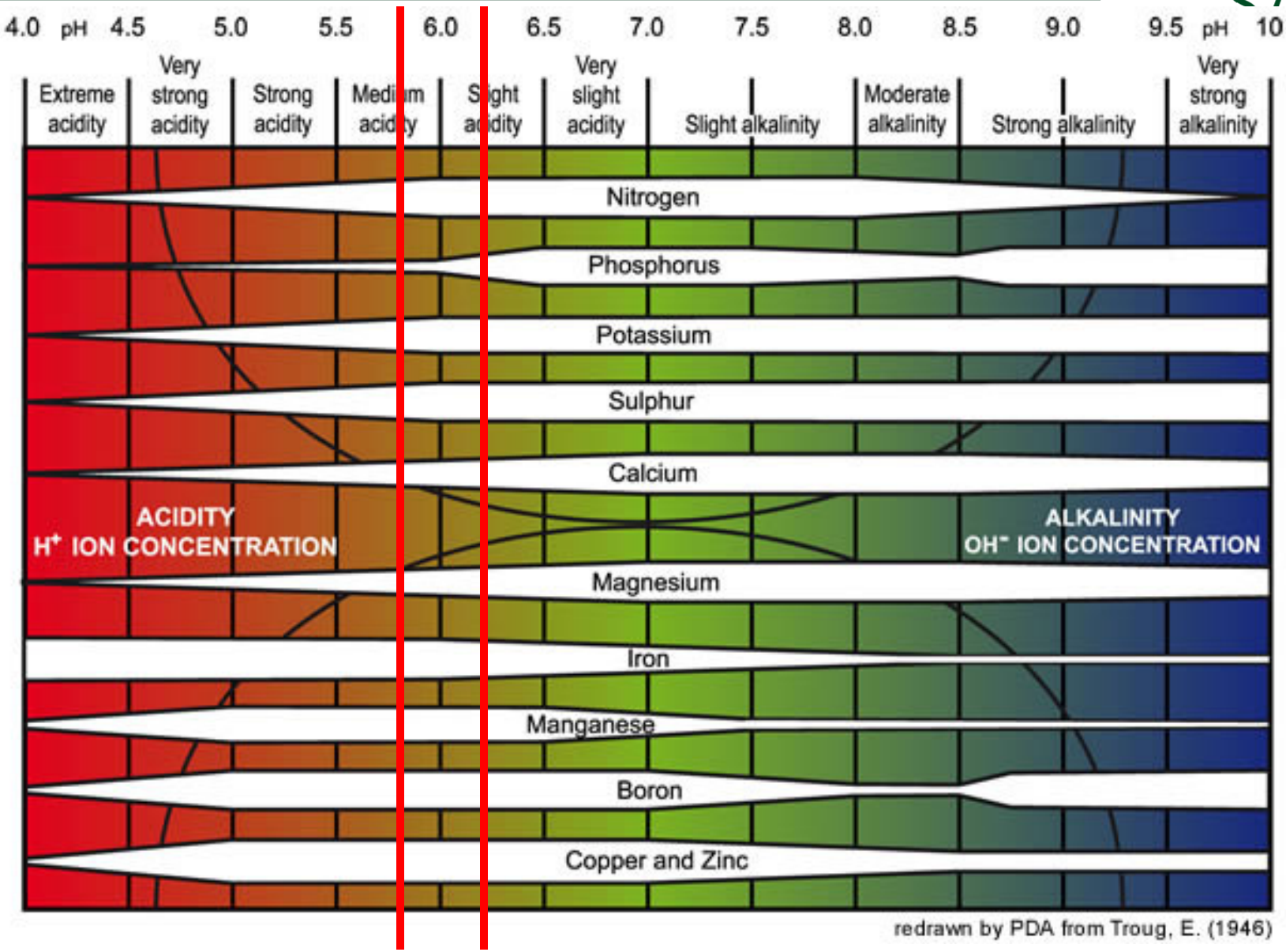
- Gain a better understanding of our soils
  - Looking at soil series maps
  - Taking time to think about variations within fields
  - Analyse your soils – pH, P, K, Mg

Why is pH so important?

- At soil pH values below 5.6 in mineral soils in Scotland soluble aluminium inhibits cereal root growth and reduces yield.
- Plant produces stubby roots instead of long fibrous roots – limits nutrient uptake
- At best limits yield, at worst crop is a right off

Notice thick, stubby roots

Limits the availability of other nutrients



Soil pH mainly varies within fields for 3 reasons

- Old field boundaries
  - Due to different cropping/liming/field histories
- Soil Texture
  - Light soils tend to drop quicker and need less lime to increase pH
  - Heavier soils tend to drop slower but need more lime to increase pH (TN656)

Soil pH mainly varies within fields for 3 reasons

- Lime application
  - Most spreaders spread to 10-12m and are notoriously variable (partly due to lime not flowing easily)
  - Under or over application tends to persist in the soil for decades
  - Application mistakes tend to be cumulative and long lasting
  - Cannot forecast where they occur.
  - Examples are
    - Lime tipped in field gateways
    - Spreaders choking/running out of lime/double application
    - Calibration errors

Technical Note TN656

SRUC

November 2013 • All

Soils information, texture and liming recommendations.

SUMMARY

- Web based access to information on your soils on your farm is described.
- Soil texture classes of mineral soils are described and identified by hand texturing.
- Liming recommendations for different soils and managements are tabulated.

1. Introduction

Scotland's soils have been comprehensively surveyed, classified, and studied over the past 75 years. Understanding and using this information at the farm level has up till now been difficult due to its complexity and the accessibility of information. The development of web based tools has changed this and The James Hutton Institute, who hold the National Soils Database for Scotland, have created the SIFSS (Soil Indicators for Scottish Soils) website which allows you to access information on your soils. SIFSS is also available as a free iPhone app for you to find out what soil type is in your area, discover the differences in soil characteristics between cultivated and uncultivated soils, and also to examine a range of key indicators of soil quality.

In this technical note the influence of soil texture on target soil pH values and liming requirements of crops and grass is described. Regular soil testing is required every 4 - 5 years in order to monitor success in maintaining targeted levels of lime. This note can be used along with PLANET Scotland, a software tool designed for routine use by Scottish farmers and advisers to plan and manage lime and nutrient use on individual fields.

There is also on-going work that will make the information relevant to how we manage our soils on a daily basis. Further technical notes are planned linking trace element status with soil parent material, texture and pedological drainage status; and rates of phosphate fertiliser to build up and run down soil P status with a different set of soil properties.

SAC CONSULTING

Cannot forecast where soil pH is likely to change

- But we can analyse using GPS to find this out
- There are two ways this can be mapped
  - Computer generated interpolation maps
  - Grid pattern

Computer generated interpolation maps

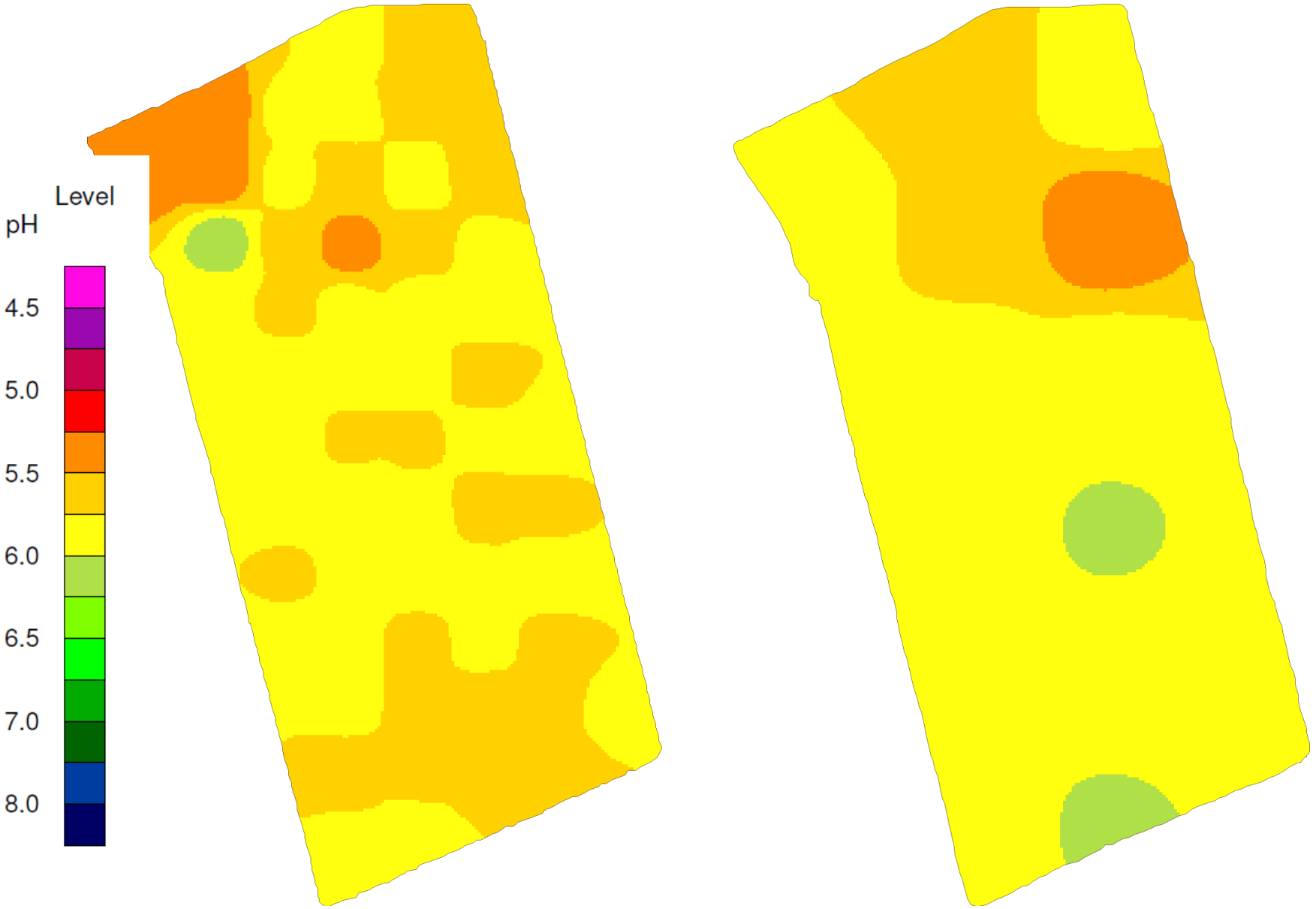
- Computer generated interpolation is notoriously difficult and unreliable when you have a small number of samples per ha (yield maps can have 100's of samples per ha so interpolation is much more reliable).

- It also assumes that the soil pH changes evenly and predictably across the field i.e. if point A is 6.0 and point B is 6.6 then half way between A and B must be 6.3.

Computer generated interpolation maps

- This is not the case in reality as soil pH can change abruptly in the field in an unpredictable manner.

Spot the difference: 4 /ha and 1 /ha



Grid Sampling

- Benefit of grid areas is that you are spreading lime on the ACTUAL pH result from the lab – not a computer generated, interpolated map of what soil pH might be.

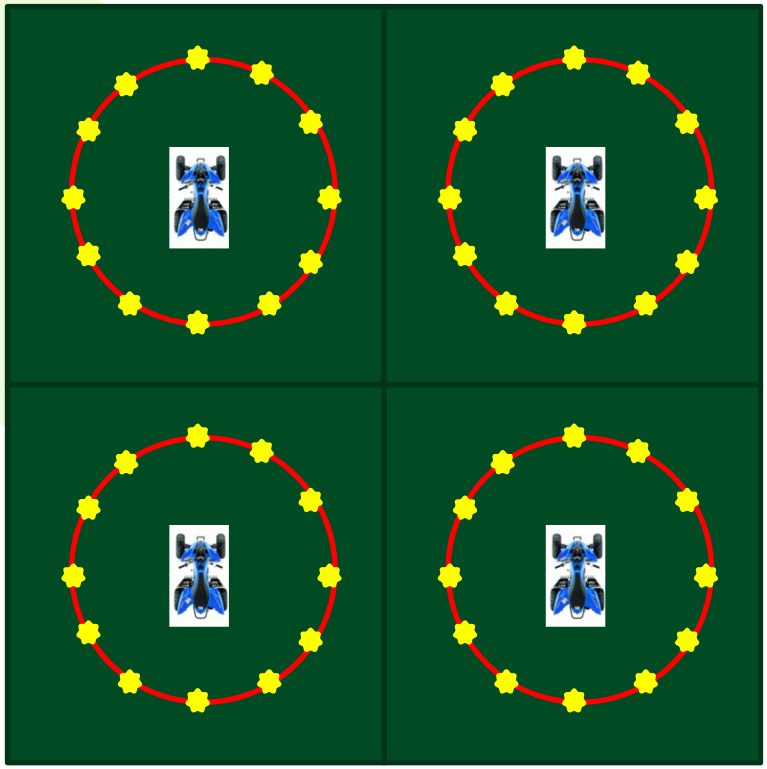
- Large amount of samples - 12 sub samples from a grid in a circle about 15m from the grid centre so that getting at least 1 sub-sample from every pass of the lime spreader when it spread lime last time the field was limed – no matter which way the spreader passed through the grid.

Grid Sampling

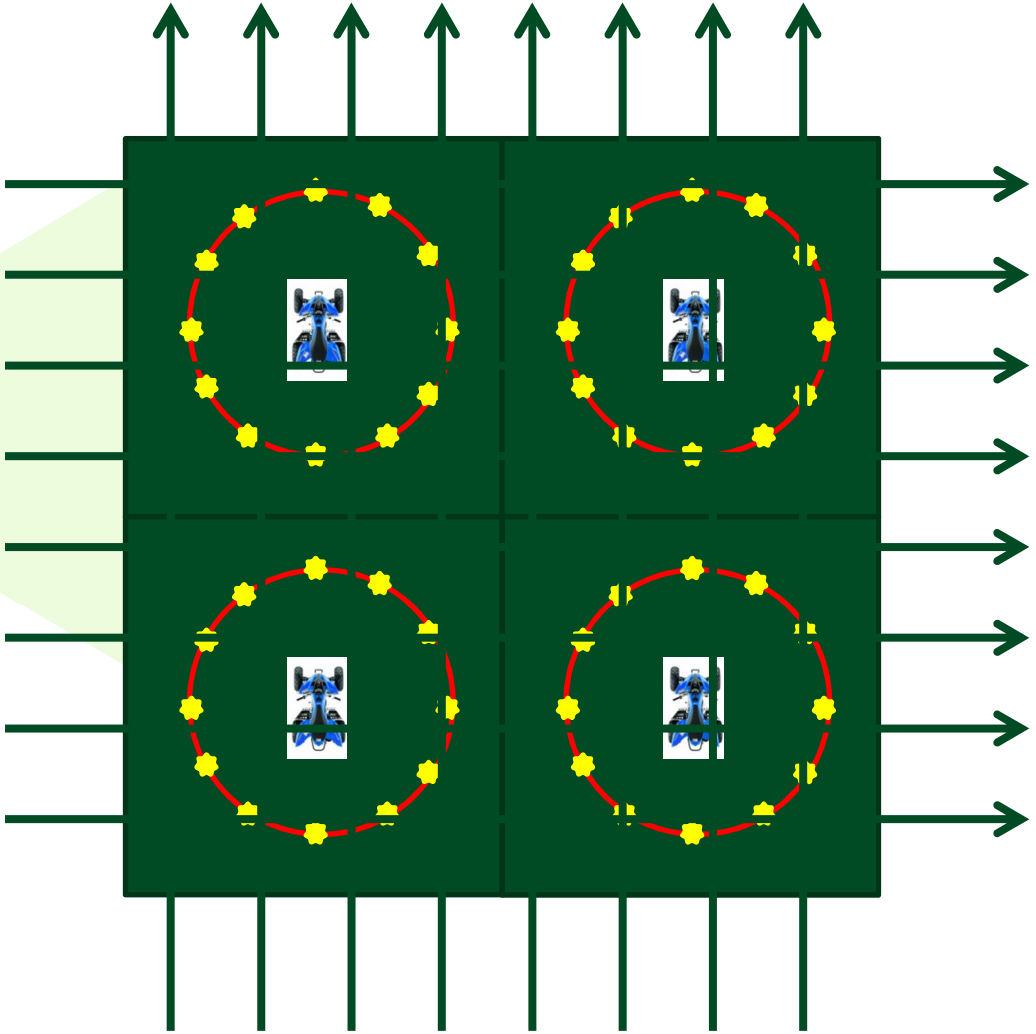
- Effectively interpolating based on physical samples, not a computer algorithm. Sampling is based on AREAS.

Grid Based Sampling

- 4 samples per ha
- 12 sub samples (48 per ha)

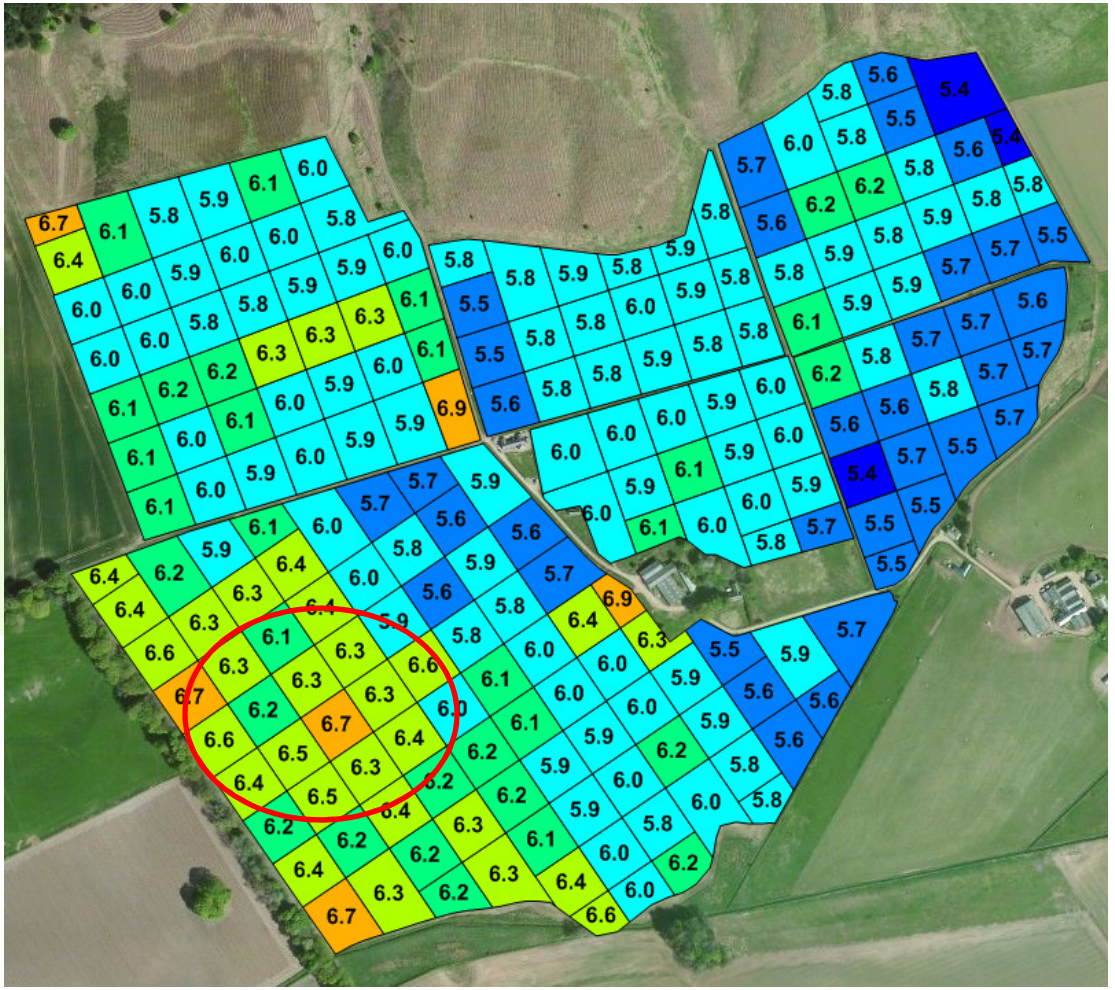


Grid Based Sampling



Map of grid areas

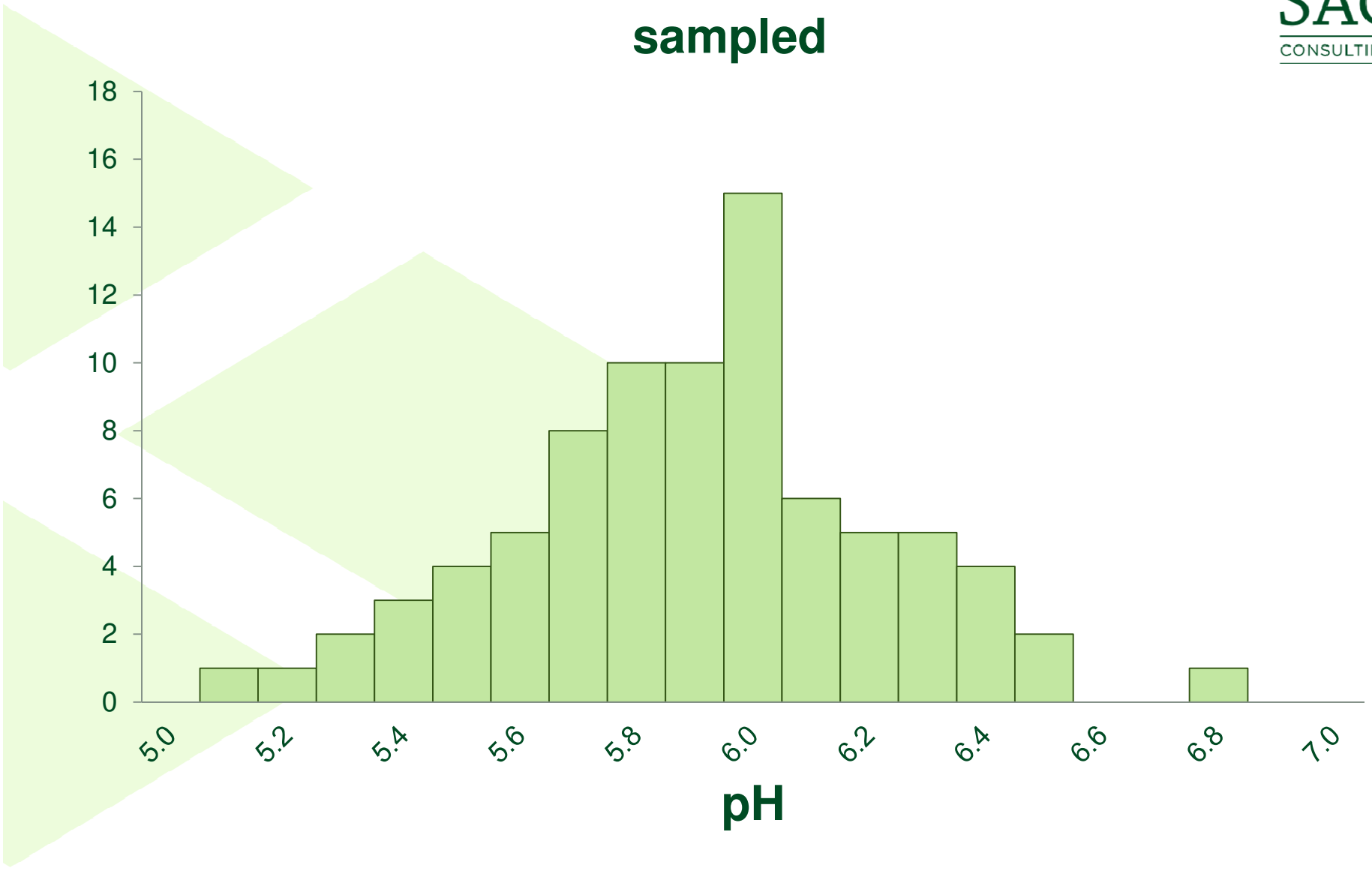
- Notice pH 6.7 bounded by pH 6.2, 6.3, 6.4, 6.5. Computer-generated map would not predict 6.7.



So what are we trying to achieve?

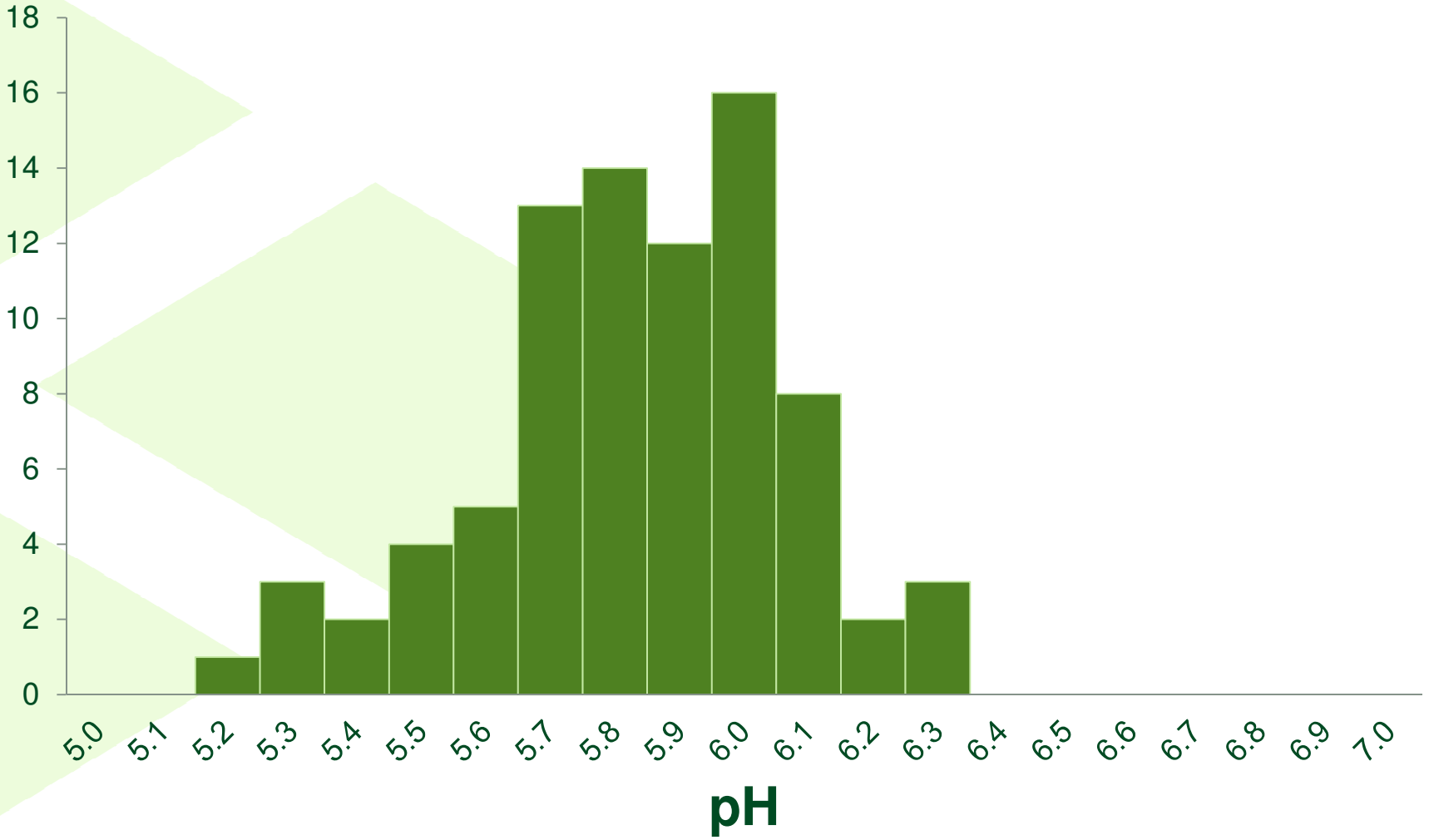
- Decrease variability
  - After the precision application of lime a field should have a more consistent pH

SAC CONSULTING



SAC CONSULTING

Second time sampled



Sampling rate & lime requirement

- Sampling rates vary: generally 1/ha to 4/ha

- A higher sampling rate
  - Is more accurate
  - Reduces variability within fields
  - Is more expensive

Remember the golden rules

- 2 t/acre (5t/ha) maximum applied in one application
- If more required split the application
- Lime can take 18 months to fully neutralise

Zoning Fields for P and K – Principles.

- Aim is to forecast where soil fertility levels are likely to change.
- pH is very variable, lower cost and crops response is high - so grid sample.
- P, K, Mg tends to be less variable, higher cost of analysis and more intensive sampling only improves crop response when soil levels are low or high.
- With experience can forecast where soil fertility levels change using old field boundaries, yield levels, soil textures and farmer/advisor experience.

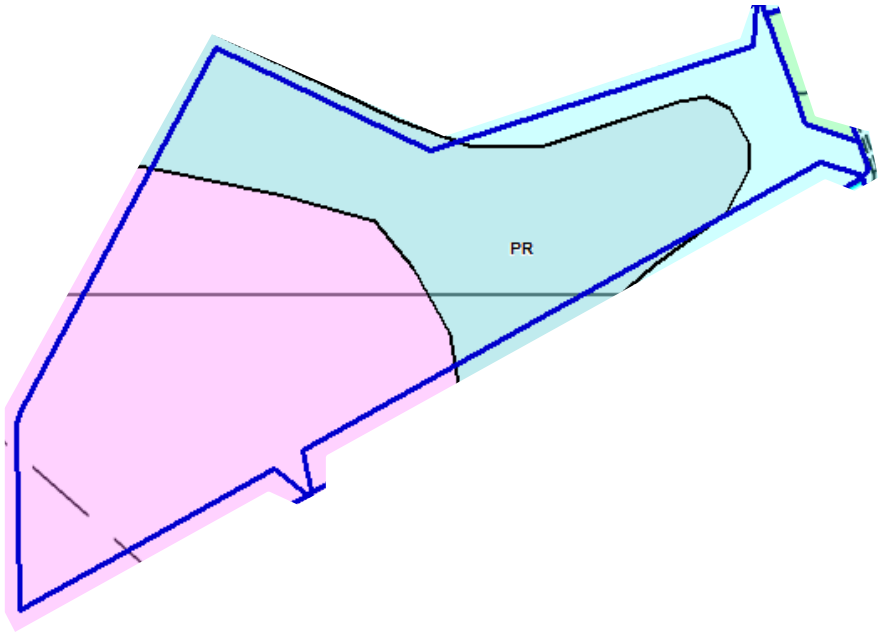
Zoning Fields: Then use Yield Zones

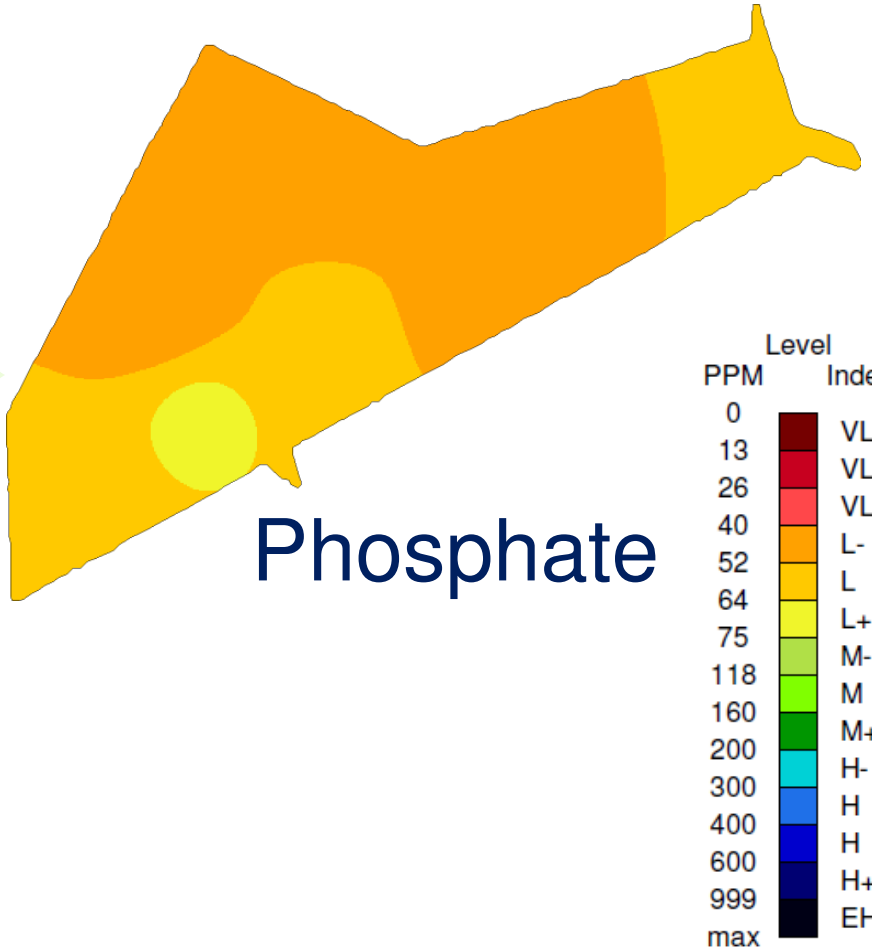
- Divide old field boundaries up into different yield zones
- If the yield changes within each old field split into low, medium and high yield zones (or just low / high)
- Also inconsistent yield zones
- High yielding areas tend to be lower in P and K due to greater removal, lower yielding areas tend to be higher in P and K due to application being greater than removal.

Zoning Fields: Finally split using other factors.

- Different soil textures – light soil will hold less nutrients.
- Slopes and hollows – subject to erosion and deposition.
- Drainage problems
- Tree shade
- Farmer and agronomist knowledge is key.

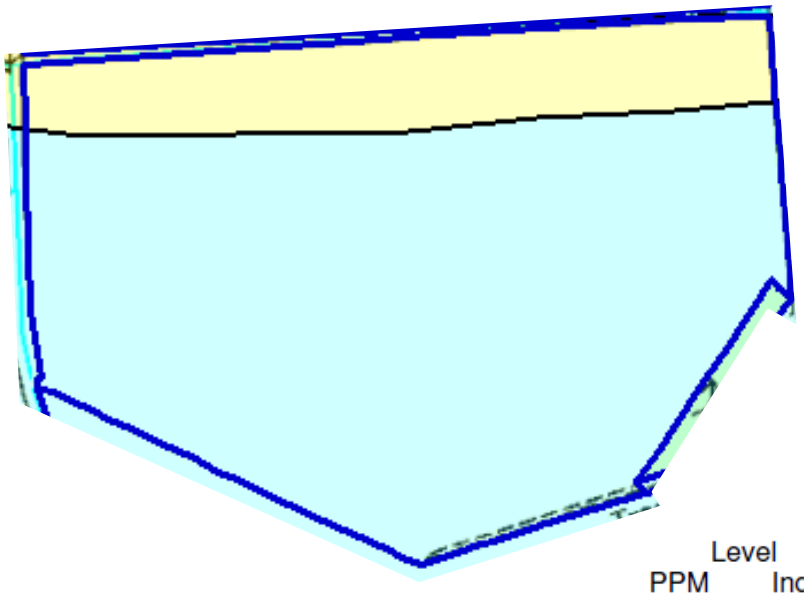
Moss and clay



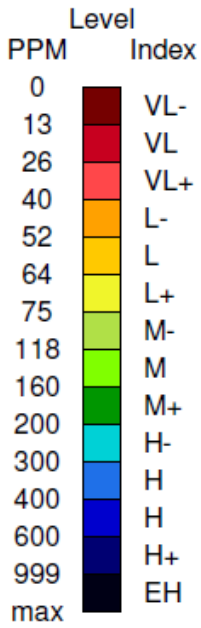


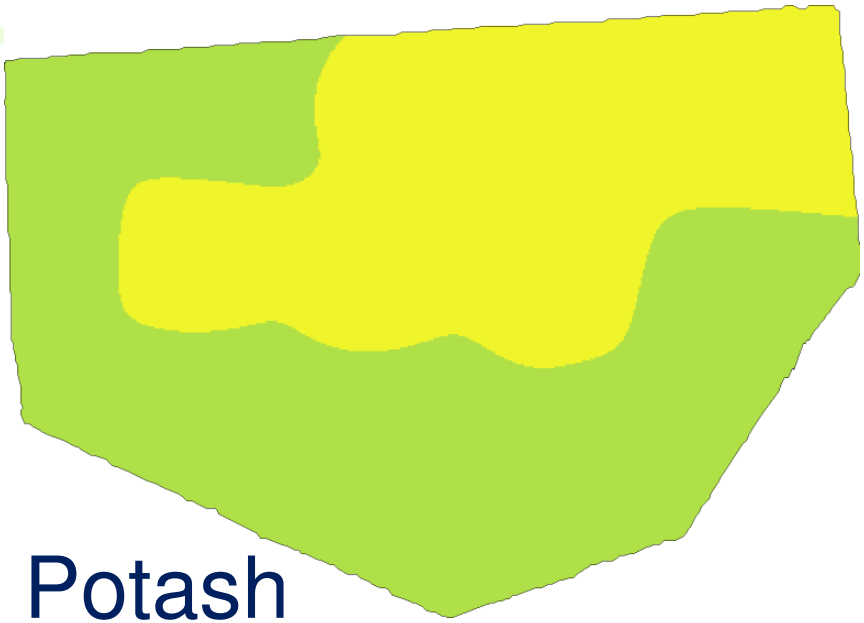
Phosphate

Alluvial bank



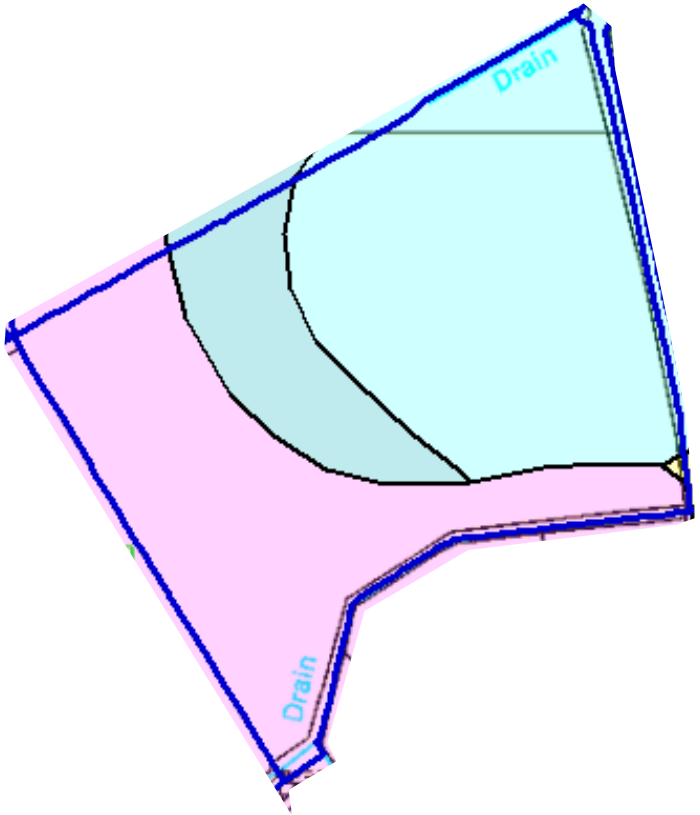
Phosphate

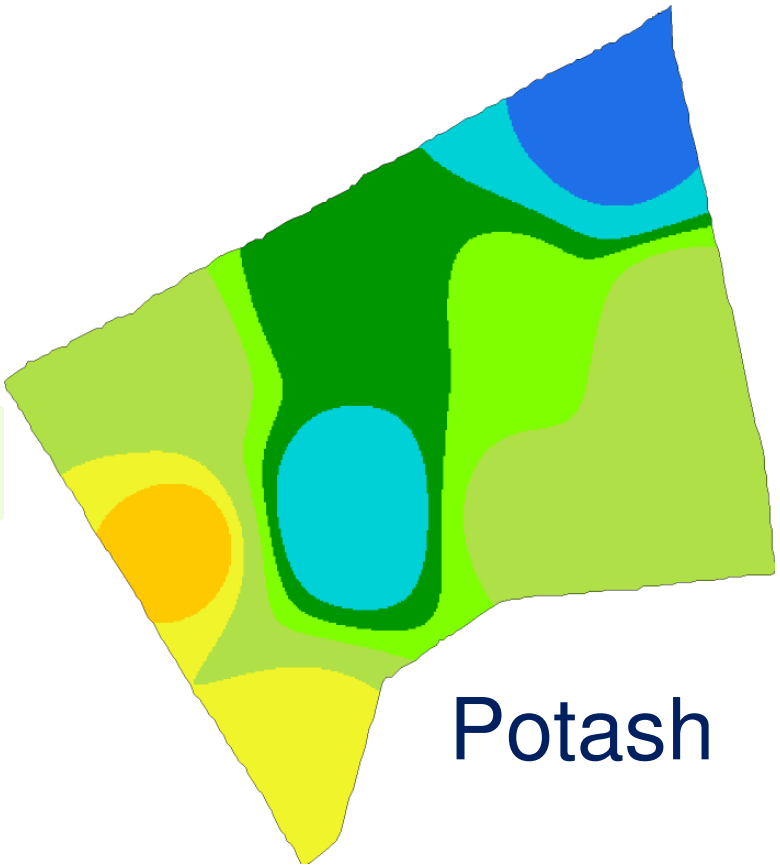




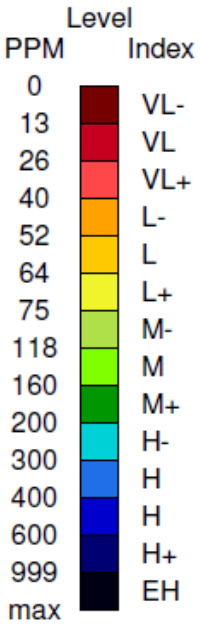
Potash

Old midden sites?





Potash



Zoning

- The use of zones can significantly reduce the soil analysis bill compared with grid sampling.
- Many fields may only have 2 or 3 zones, so less costly soil analysis needs to be carried out.
- Is it worth the cost saving?

So pH, P and K are at an optimum so what next?

- pH will require retesting and spreading again within 5 years
- Once P and K, are in the recommended status for your rotation it's a case of maintaining the status
  - Rotation without potatoes P = M, K = M-
  - Rotation with potatoes P = M, K = M+

Replace what is being taken off by the crop (TN633)

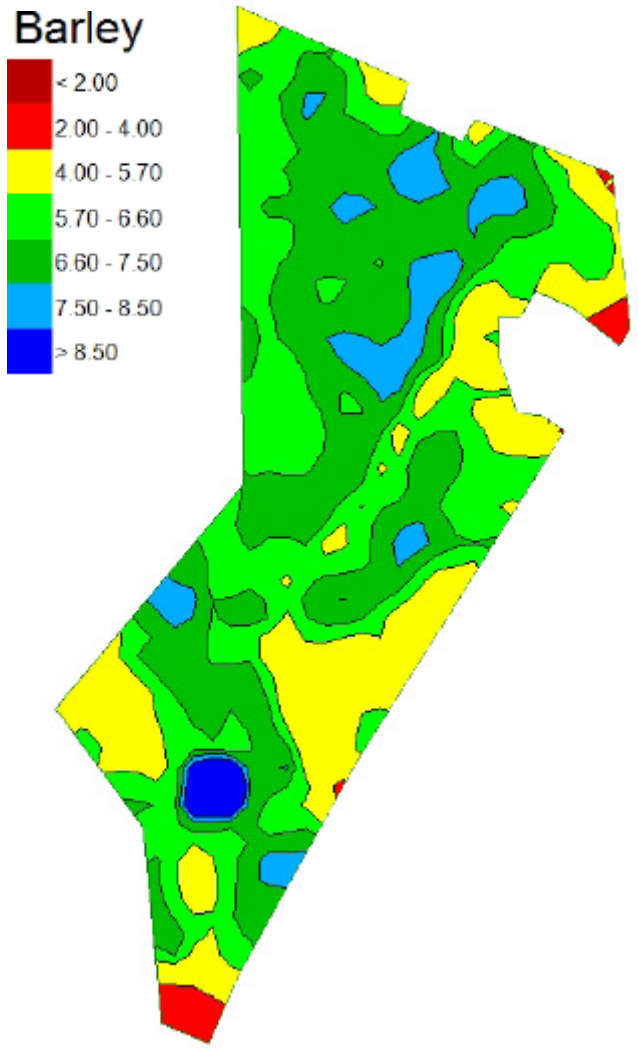
Crop	Yield (t/ha)	P Removal (kg/ha)	K Removal (kg/ha)
Winter Barley	8.4	67	83
Winter Wheat	8.4	67	83
Spring Barley	6.0	52	71
Spring Oats	6.0	53	104
Winter Oats	6.0	53	104

Replace what is being taken off – Yield Maps

- Utilise yield mapping data to replace what the previous crop take off thus maintaining soil P and K status

Replacing off take – Spring Barley

Yield (t/ha)	P (kg/ha)	K (kg/ha)
2.00	17	24
2.00 – 4.00 (3.00)	26	35
4.00 – 5.70 (4.90)	42	58
5.70 – 6.60 (6.2)	53	73
6.60 – 7.50 (7.00)	60	83
7.50 – 8.50 (8.00)	69	94
>8.50	73	100



Conclusion

- Tackle pH first – it's the key to soil health
- Use your own knowledge and information to hone how you sample for P and K
- Once you have got to the required status then use a nutrient balance to maintain the status
- Use yield information if available

SRUC

The Scottish Government

This presentation was funded by the Scottish Government as part of its Public Good Veterinary and Advisory Services